COMPUTING HELL

By Charles Day

"LET US ALWAYS KEEP BEFORE OUR MIND'S EYE AN OVERHEATED AND GLOWING STOVE AND INSIDE A NAKED MAN, SUPINE, WHO WILL NEVER BE RELEASED FROM SUCH PAIN. DOES NOT HIS PAIN APPEAR UNBEARABLE TO US FOR EVEN A SINGLE MOMENT?"

Thus wrote the 15th-century theologian and mystic Denis the Carthusian in his tract about the Last Judgment, *De quatuor hominis novissimus*. When I encountered the passage in Johan Huizinga's *The Waning of the Middle Ages* (1919), another, more recent book came to mind: Iain M. Banks's science fiction novel, *Surface Detail* (2010).

The novel's action takes place in our galaxy in 2970 AD. By then, technology has reached the point that a person's consciousness can be recorded and inserted into virtual, simulated worlds—including hells of such fiendishly imaginative gruesomeness that I'll refrain from quoting a description. Some of the galaxy's species support the hells as an effective means to discourage bad behavior; others decry them as a moral outrage. To settle the hells' disputed existence, the various interested species have agreed to abide by the outcome of a vast simulated war game.

Virtual, simulated worlds have been featured in science fiction for some time. My first encounter with them—and perhaps yours, too—was in William Gibson's *Neuromancer* (1984). The novel's complex, thrilling plot involves two powerful and resourceful artificial intelligences and a cast of drug-addicted hackers, former special operations soldiers, plutocratic industrialists, and cyberpunk ninjas.

Gibson favored a mostly metaphorical description of computed reality. In *Permutation City* (1994), Greg Egan delves in more technical detail into the philosophical questions of simulated afterlives. Presciently, in Egan's near-future world, computing power is available in abundance via the cloud. With such resources, Paul Durham, a computer scientist and entrepreneur, proposes to create a self-sustaining virtual world where scanned consciousnesses can live for eternity.

In reality, though, how likely is the prospect of scanning a consciousness and uploading it into a virtual world? Human brains contain 10^{11} neurons that form 10^{15} interconnections. Storing a static map of something that big isn't beyond current technology. CERN has already amassed 2×10^{17} bytes of data from the Large Hadron Collider.

The bigger technological challenge, I think, lies in generating the map in the first place. Conceivably, neuroscientists could discover a modest set of principles that embody how our brains are networked, obviating the task of mapping individual neurons. But if they can't, every neuron and synapse would have to be located. Super-resolution techniques such as Stochastic Optical Reconstruction Microscopy (STORM) and Photoactivation Localization Microscopy (PALM) can already map fluorescently tagged molecules with a spatial resolution of a few tens of microns, but only—so far—in samples just a few millimeters thick.

Although it's not physically impossible, like faster-than-light travel, or physically impractical, like *Star Trek*-style teleportation, brain mapping remains scientifically out of reach, but comfortably within the realm of science fiction. As for Denis the Carthusian, he reported making mental excursions into purgatory, during which he received revelations and conversed with souls. That experience is not unlike a *Neuromancer* hacker "jacking into" cyberspace and meeting avatars.

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